Understanding mathematical modelling tools to evaluate China's future energy-economy interactions

ETSAP TIAM 18R model with 3 Chinese regions – early results

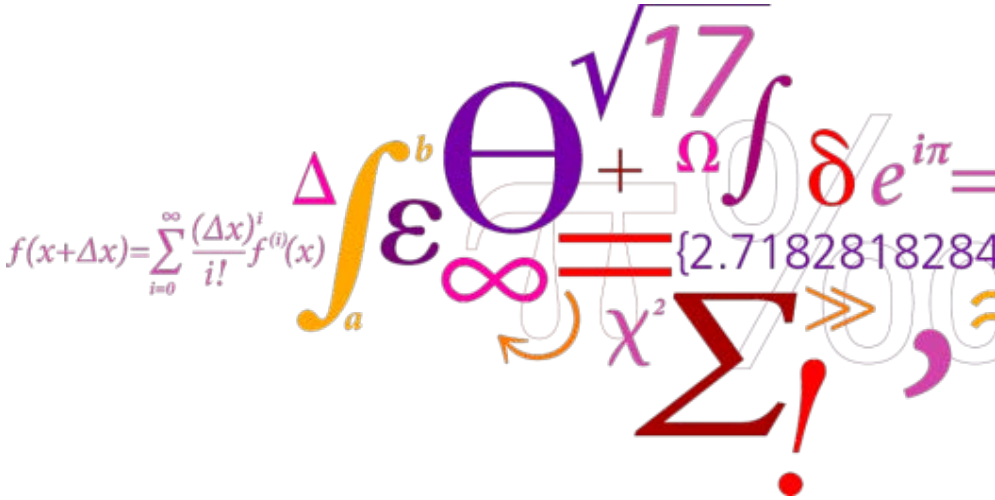
Mischke, Peggy

Publication date:
2013

ETSAP TIAM Workshop 2013

Understanding mathematical modelling tools to evaluate China's future energy-economy interactions

ETSAP TIAM 18R model with 3 Chinese regions – early results



ETSAP Meeting in Paris, France
June 17, 2013

Peggy Mischke
Denmark Technical University
System Analysis
PhD candidate
peym@dtu.dk

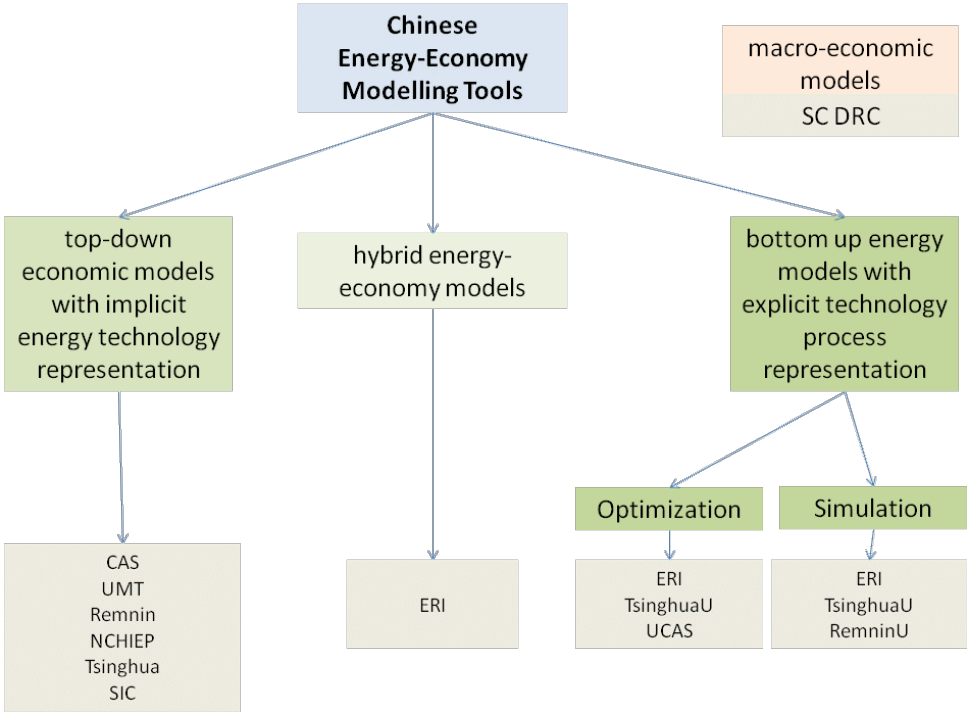
Understanding mathematical modelling tools to evaluate China's future energy-economy interactions

PART I

A growing number of Chinese energy system models is developed

- 18 modelling tools developed by 9 Chinese institutions were identified

- review criteria:
  - Model developed by a Chinese institution
  - Model results published in English
  - Publication from 2005-2012 included



Chinese energy-economy model	Representing Chinese Institution	Modelling approach	Access to model information in English	Recent international model comparison studies and international research projects	Number of publications since 2005
BOTTOM UP					
2050 Calculator	Energy Research Institute (ERI), Beijing	Bottom up, Simulation	Dedicated website	UK 2012	0
(2050 Low Carbon Model)	Energy Research Institute (ERI), CNREC, Beijing	Bottom up	Research reports	DK 2013 forthcoming	
CRESP Economic Evaluation Model	Energy Research Institute (ERI), China Renewable Ene CRESP, Beijing	Bottom up	Research reports	ESMAP Low Carbon Growth Country studies 2012	2
LEAP China	Tsinghua Unive		ic papers		more than 5
MESSAGE China	University of Ch Sciences, now		ic pa		1
Power Mix Planning Model	Tsinghua University, Beijing	Bottom Up	Academic pa		1
PECE Technological Optimization Model	Remnin University, Beijing	Bottom up	Research rep Academic pa		3
MARKAL China model family	Tsinghua University, Beijing	Bottom up, Optimization	Academic pa research repo	BASIC 2007	more than 5
TIMES China model family	Tsinghua University, Beijing	Bottom up, Optimization	Academic papers		1
TOP DOWN					
IPAT	University of Mining Technology, Xuzhou, Jiangsu Province	Top down, set of equations	Academic papers		1
CGE model	State Council Development Research	Top down, CGE, CES function	research reports	World Bank 2012, EU BASIC 2007	4
SIC	on Center	Top down, CGE, CES function	research reports	OECD 2013, EU BASIC 2007	3
PE	sity, Beijing	Top down, CGE, CES function	Academic papers	EU BASIC 2007	2
MI	my of Sciences, Beijing	Top Down, IO	Academic papers	EU BASIC 2007	2
IO model	Tsinghua University, Beijing	Top down, IO	Academic papers		1
Portfolio optimization model for power	University of Science and Technology, Hefei	Top Down	Academic papers		1
CGE model	North China Electric Power University	Top down, CGE, CES function	Academic papers, research reports		1
HYBRID					
IPAC model framework	Energy Research Institute (ERI), Beijing	Bottom up IPAC	Academic papers,	Asia Modelling exercise 2013, EC2 2012, US LBNL China model comparison 2010, EU BASIC 2007, UNEP RISO 2007, ongoing projects POEM & ROSE	more than 5

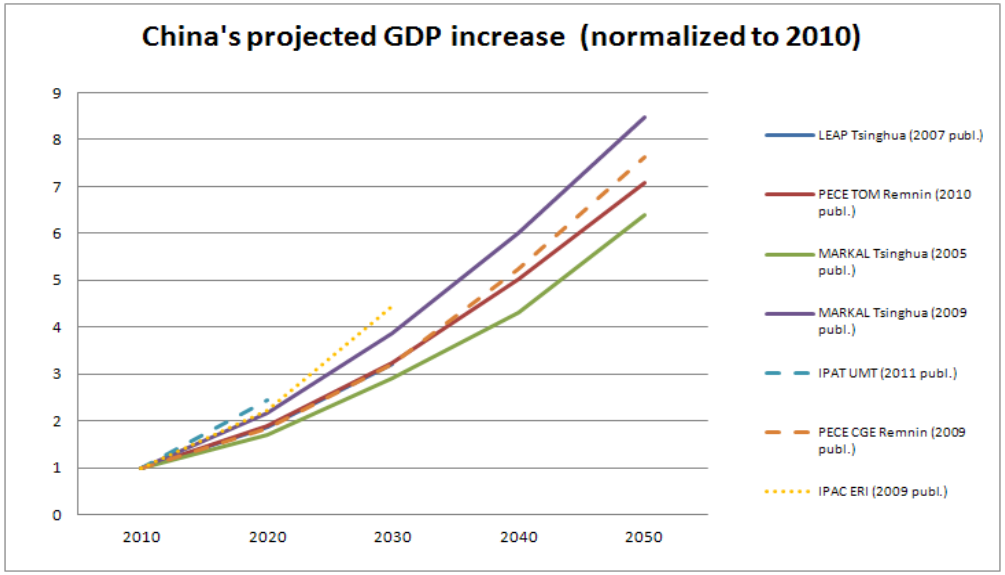
ERI and Tsinghua with many bottom up models

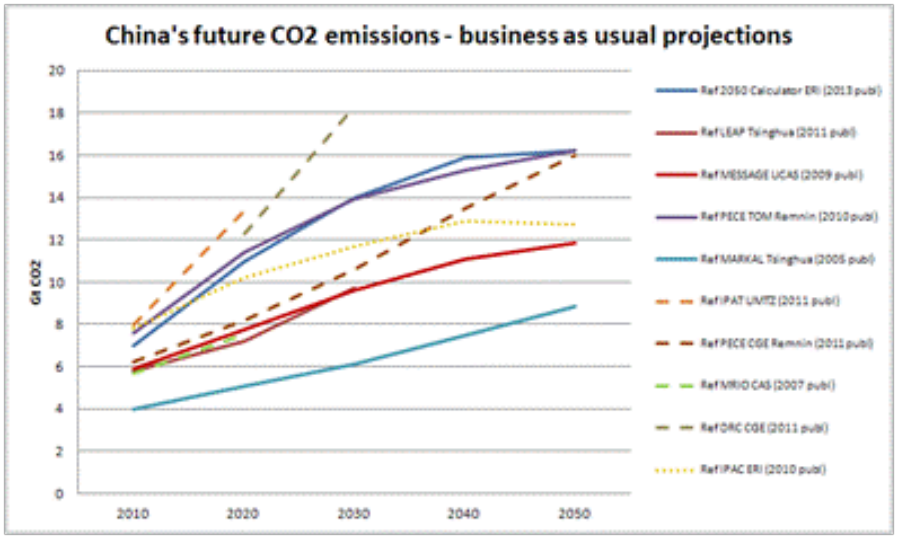
many cooperations, but fewer regular English journal publications

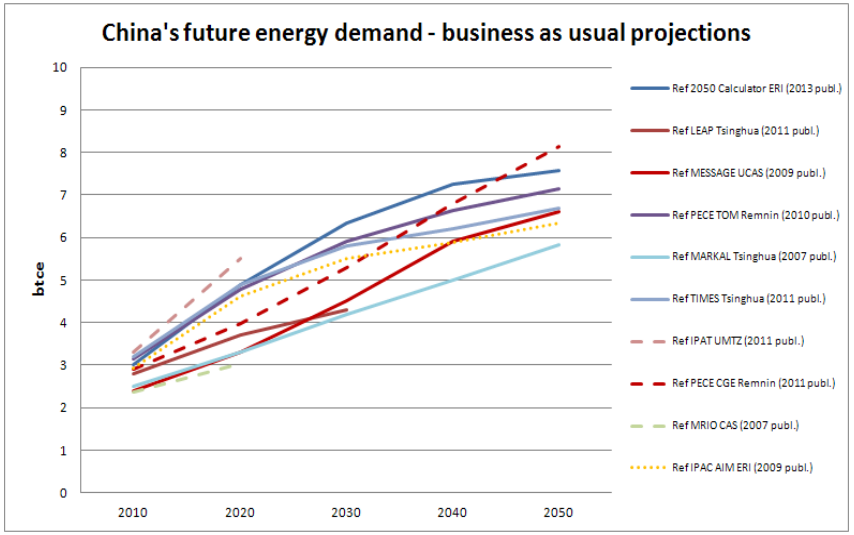
many institutions developping CGE models

one hybrid model participating in most international projects

Business as usual in China - some common characteristics







Main policy conclusions

- Much concern about costs implications
- Many models suggested a cleaner and more efficient use of coal, partly combined with the increased nuclear power
- Some of the modelling studies advised against short term emission reduction targets and emission peaks for China. Some modelling studies suggested a potential emission stabilization period for 2035-2050.
- Only a few modelling studies pointed out to benefits of increased use of renewable energies in China.

→a cautious perspective to control China's growing energy demand, highlighting a rather long term approach with a gradual technological shift away from coal

→ forthcoming paper in ENERGY for more information

ETSAP TIAM 18R model with 3 Chinese regions – early results

PART II

What to expect from an improved regional representation of China

- China's economic development is characterized by increasing dispartities between EAST coastal provinces, Central provinces and Western "hinterland" – resulting in different energy system characteristics.

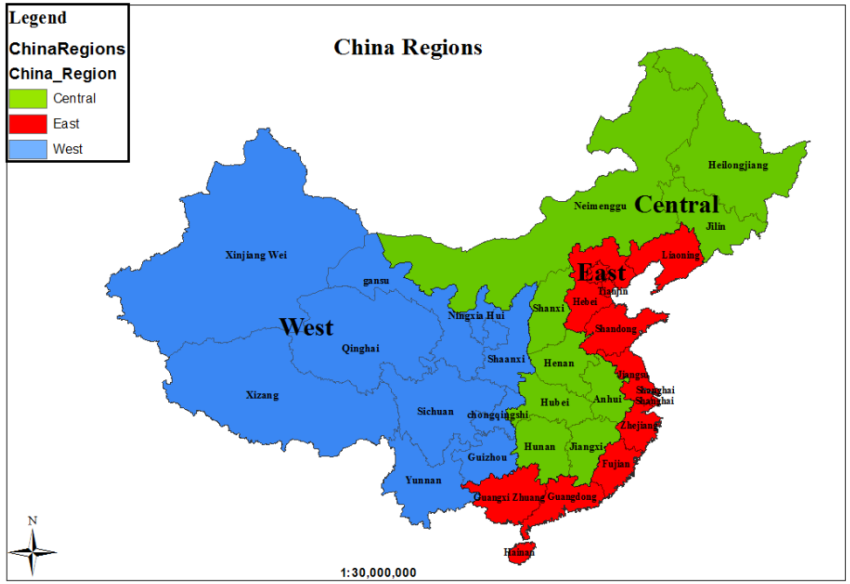
An improved regional modelling of China in ETSAP TIAM is expected to:

- highlight energy system bottlenecks and ressource limits inside China (e.g. limiting capacities for coal transport, limit of regional hydropower resources)
- assess different regional/provincial emission targets discussed for China in a global context
- review future demands for China according to regional differences in economic development (e.g. analyse policies of developing the WEST after the model of EAST)

Methodology for a regional split of China in ETSAP TIAM

DONE:

- Splitting of China's national energy balance in BY templates of ETSAP TIAM 15R (2011 version) into 3 regional energy balances
- Integrating Chinese national statistics from various sources to derive share assumptions for regions
- Deriving a ETSAP TIAM 18R model version by integrating new BY templates for Chinese regions and implementing regional specific definitions in other required files



NEXT STEPS

- Quality check including reviewing 18R outputs in comparision with ETSAP TIAM 15R reference
- Finetune data assumptions and scenario definitions during next China reasearch stay

Early results – some highlights

- Quality checks ongoing -dummy imports minor, but increase in overall system costs
- regions of China visible with different future power systems configurations
- national and regional GHG emission curves for China available
- new inner China trade options (so far for coal, oil and gas)

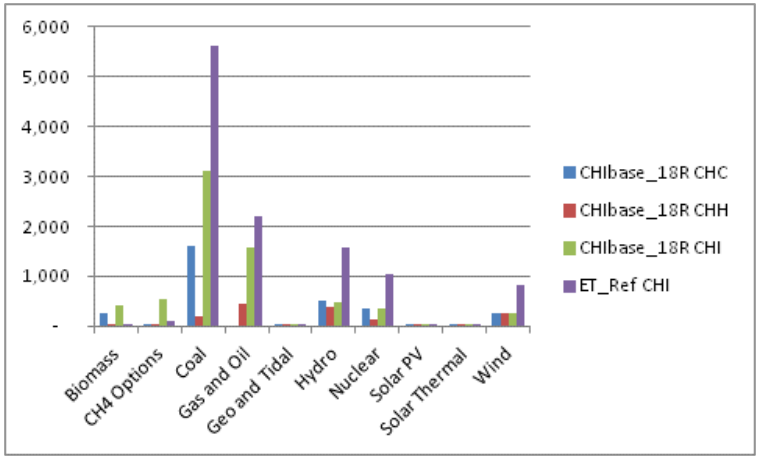


Table Name: Trade bilateral			
Active Unit: PJ			
	Attribute	VAR_FIn	VAR_FOut
Commodity	Region\Period	2050	2050
COAHCO	CHC	0	58126
COAHCO	CHI	58126	0
OILCRD	CHC	0	4691
OILCRD	CHI	4691	0
OILDST	CHC	0	3270
OILDST	CHI	3270	0